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The United Kingdom's Naval Shipbuilding Industrial Base

The Next Fifteen Years

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Summary

The United Kingdom's Ministry of Defence (MOD) is in the early stages of an ambitious effort to renew and upgrade its naval fleet over the next two decades through the production of new ships and submarines. Defence policymakers are seeking to gain a fuller understanding of the ability that shipyards, workers, and suppliers in the United Kingdom have to produce and deliver these vessels at the pace and in the order planned by the MOD.

This analysis, done at the request of the MOD's Defence Procurement Agency (DPA), focused on answering three fundamental questions: Can the existing shipbuilding industrial base meet future demands? Do problems exist with the numbers and types of facilities or the numbers and skills of the workforce? and If problems exist or can be anticipated, what can be done to alleviate them?

Relying both on public and proprietary data and on surveys of government and industry representatives,² the analysis addressed these questions by examining the capacity of the UK industrial base's current workforce and facilities, identifying the demands for these resources over the next two decades and exploring options to address situations in which future demands might exceed capabilities. The study aimed to help MOD policymakers (1) gain an understanding of the capacity of the United Kingdom's naval shipbuilding industrial base to successfully implement the MOD's current acquisition plan,

² By industry, we include naval shipbuilders and repairers; suppliers; design firms; and firms involved in commercial maritime work (i.e., offshore industry, commercial repairers, and producers).

and (2) gauge how alternative acquisition requirements, programmes, and schedules might affect the capacity of that industrial base.

MOD Ship Programmes³

The MOD is planning an extensive shipbuilding programme for the next 15 years, which can be divided into two main categories. The first category comprises programmes on contract that have already passed through the MOD's final approval process (Main Gate) and are somewhere in the demonstration and manufacture stage. The second category comprises prospective programmes that have yet to pass Main Gate but which the MOD anticipates will be built. Of course, the future procurement programmes continue to evolve in line with the strategic environment, financial imperatives, industrial developments, and new opportunities. Any statement of the programmes themselves, the number of ships, and the timings are speculative—particularly for the second category of programmes not yet past Main Gate. Thus, the reader must keep this caveat in mind when interpreting the results.

Table S.1 describes the *potential* future ship programmes and the potential size of their production runs.

Figure S.1 lays out the potential design and production timelines for the future programmes as identified in Table S.1.

The blue bars represent the programmes (or portions of programmes) that are past Main Gate and on contract. The grey bars represent the programmes that are either pre–Main Gate or potential additional procurements for the class that have not been contracted. The timings are a synthesis of our assumptions, data provided by the Integrated Project Teams (IPTs), and data provided by the shipyards. The dates are representative only and are not fixed as certain or are specific requirements from the Equipment Capability Customers.

³ The information for this section is extensively drawn from the DPA's Web site (www.mod.uk/dpa/ipt/index.html) on the agency's current projects, the Royal Navy Web site (www.royal-navy.mod.uk), and Royal Navy (2003).

Table S.1
Future MOD Ship Programmes

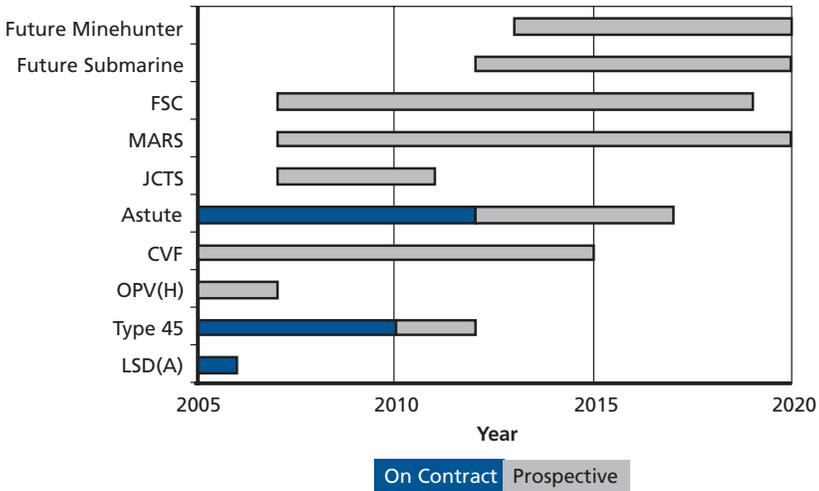
Programme	Description	Potential Production Run
On Contract/Past Main Gate		
<i>Astute</i> -class attack submarine	The <i>Astute</i> is a new nuclear attack submarine (SSN) intended to replace the existing <i>Trafalgar</i> and <i>Swiftsure</i> classes. It is being designed for the support of the <i>Van-guard</i> ballistic nuclear submarine (SSBN), antisubmarine warfare, anti-surface warfare, surveillance and intelligence gathering, and land attack. There are three ships currently on order with the potential of six more acquired, for a total of nine.	9
<i>Bay</i> -class landing ship dock (LSD[A])	These new vessels are part of the Royal Fleet Auxiliary's (RFA's) rapid deployment force and will replace various landing ship logistic (LSL) classes in the RFA fleet. The LSD(A)'s main role is logistic support, bringing troops, trucks, tanks, and cargo into battle. It can also be used for humanitarian missions.	4
Type 45	Type 45 will be a multi-role destroyer whose principal mission is anti-air defence (DDG). The first six ships of the class are currently on order. There is a potential for up to six additional ships to be procured. Both BAE Systems (Clyde Shipyards) and VT Shipbuilding ^a (Portsmouth) are involved in the production of these ships.	12
Prospective/Pre-Main Gate		
Future Aircraft Carrier (CVF)	CVF is the Royal Navy's next generation of aircraft carrier, meant to replace the current <i>Invincible</i> -class (CVS) carrier.	2
Future Surface Combatant (FSC)	FSC is notionally thought to be frigate-sized vessel and will replace the Type 23's and Type 22's currently in the fleet.	14
Joint Casualty Treatment Ship (JCTS)	JCTS is single-ship programme that will provide advanced medical capabilities to all three UK services. The ship can be used for combat operation support as well as humanitarian missions. As a 'grey hull' and therefore designated to operate within a task force, the ship will not be subject to the Geneva Conventions as would a conventional hospital ship.	1
Military Afloat Reach and Sustainability (MARS)	The MARS programme will be a series of ships (number and types currently undefined) that will provide supplies to the fleet and forces ashore. These supplies are a combination of dry goods and provisions, general stores, water, ammunition, and fuel products.	10

Table S.1—Continued

Programme	Description	Potential Production Run
Offshore Patrol Vessels– (OPV[H])	The Royal Navy has provisional plans to replace the <i>Castle</i> class of offshore patrol vessels now in use in the Falkland Islands. These new ships will have the ability to operate helicopters and will be leased on a similar basis as used with <i>River</i> -class patrol vessels.	2
Future Submarine	This submarine will be a follow-on to the <i>Astute</i> class. Its current size and mission are not yet defined.	7
Future Minehunter	This class will replace the minehunters currently in the Royal Navy fleet.	4

^aPart of VT Group, formerly known as Vosper Thornycroft.

Figure S.1
Schedule of MOD Naval Programmes, 2005–2020



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Figure S.1 shows that there will be periods when up to *six* programmes will be in various stages of design and construction. Not only will there be high concurrency, but these ships produced will be

the largest of their type built in quite some time. This situation contrasts the current case in which there are only three programmes on contract. In 2010, for example, the Type 45, CVF, Astute, JCTS, MARS, and FSC programmes will all be under way simultaneously; however, not all these programmes will be in production at the same time. Nonetheless, the period between 2007 and 2013 is much busier for naval shipbuilding than has been seen recently.

Today, only a handful of UK shipbuilders will likely be able to produce these naval ships. After decades of consolidations and bankruptcies in the UK shipbuilding industry, only three major firms are currently involved in building ships for the MOD: BAE Systems, Swan Hunter, and VT Shipbuilding. In addition, there are three firms primarily involved in the repair of warships: Babcock Engineering Services, Devonport Management Limited, and Fleet Support Limited. For purposes of this report, the shipyards owned by these six firms are collectively termed 'naval shipyards'. An additional firm, Ferguson Shipbuilders, is also active but focuses mainly on the coastal patrol, ferries, fishery protection, and other commercial markets.

Policy Issues Pursued by RAND

This substantial MOD building programme, combined with the United Kingdom's diminished industrial base, raises a number of questions for defence policymakers:⁴

- Is the MOD shipbuilding plan feasible given the constraints of the industrial base?
- What is the programme's effect on the shipbuilders and ship repairers?

⁴ An equally important issue, but beyond the scope of this study, is whether government can afford the shipbuilding plan. The increased level of shipbuilding activity will result in greater defence spending for naval acquisition. Whether this greater level of spending can be accommodated within the broader defence budget is not clear.

- Is the supplier base robust enough to meet the demand?
- Are there alternative timings for programmes that make the plan more robust?
- What is the effect if procurement quantities change?

At the request of the DPA, researchers of the RAND Corporation began addressing these questions in the autumn of 2003. Their main goal was to help MOD decisionmakers understand the capacity of the UK naval shipbuilding industrial base and its ability to undertake the MOD's shipbuilding programme over the next 15 years.

Study Structure

To analyse the issues facing the MOD, we decomposed the capacity evaluation into a supply and demand assessment in three distinct areas: labour, facilities, and suppliers. The study team evaluated these areas with respect both to the MOD's 'current plan' (which assumes that everything will be built as envisioned by the MOD's programme managers) and to several alternative shipbuilding scenarios:

- a pessimistic funding scenario, in which funding and/or requirements decrease such that fewer vessels are purchased
- an optimistic funding scenario, in which requirements and funding increase
- a new submarine scenario, in which a new, large submarine is designed and built
- a 'level-loaded' scenario, in which design and production timings are lengthened.

Our evaluations depended on two surveys that we conducted with firms involved in the shipbuilding industry and on interviews with government officials and industry associations. The first survey that the RAND team sent out requested information from several dozen firms involved in maritime design, repair, and production on their employment, future workload demands, facilities available, and

their key suppliers. The second survey went to some 200 key suppliers that the firms had identified in the first survey. This latter survey asked the suppliers about their employment, the relative competitiveness of their market, their dependence on MOD and maritime work, and the challenges they anticipate in the future. After receiving both surveys, the RAND team held follow-on conversations with industry representatives to clarify data and discuss issues about which the surveys had not inquired.

In addition, the RAND team interviewed officials at a number of industry associations and government agencies.

How Will the MOD Programme Affect Shipyard Labour?

Labour Demand

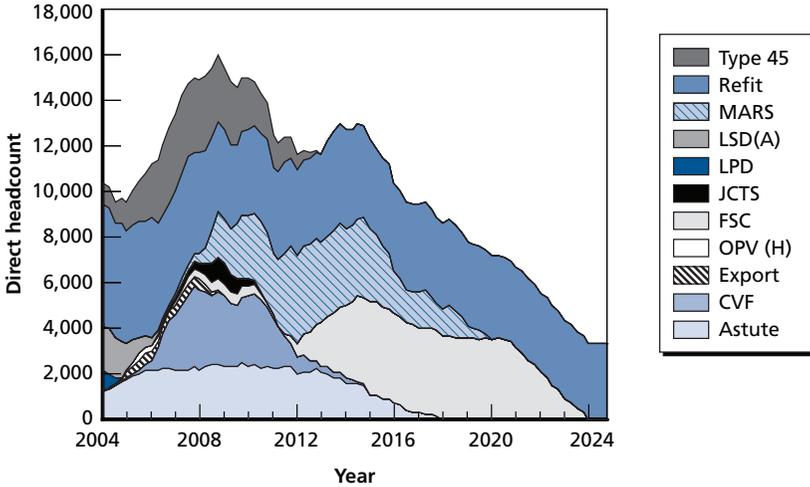
This part of the analysis depended on a labour projection model that the RAND team developed.⁵ The team used data obtained in the first survey of shipyards to populate this forecasting model, which allowed it to estimate future demands for labour emerging from the current MOD acquisition plan and from the alternative scenarios described above.

The team's analysis of the current MOD plan found that overlap of four large programmes—the Type 45, CVF, MARS, and Astute—is likely to cause demand for direct labour (all skills—e.g., management, technical, and manufacturing) to peak in 2009 at a level about 50 percent higher than the 2004 demand levels. Once past the peak, overall workload demand steadily declines for the foreseeable future. We show this workload projection in Figure S.2.

Structural and outfitting trades likely will show the most significant increase (in absolute terms). The technical workforce demand presents a more difficult challenge. The RAND team found that there

⁵ See Arena, Schank, and Abbott (2004) for more details.

Figure S.2
Future MOD Labour Demands, by Programme



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could be a sharp drop-off in demand for the technical workforce⁶ in the next two to three years, resulting largely from the rundown of the design work for the Type 45 and Astute. Thereafter, the trend reverses dramatically as CVF, MARS, and JCTS place near-simultaneous demand for technical workers. In the span of a few years, the demand for technical workers nearly doubles from its low.

With one exception, the other scenarios we explored also involved similar sharp increases in demand for production labour followed by steady decreases. Such increases in labour demand will force the naval shipbuilding and repair industrial base to rapidly increase its workforce, especially in specific outfitting, structural, and technical skills. Demands for technical workers under the alternative scenarios are much the same as the current plan. After an initial decline, the demand for these workers increases drastically. One

⁶ Technical workforce includes the follow functions: design, drafting/CAD, engineering, estimating, planning, and programme control. See Appendix C for more detail.

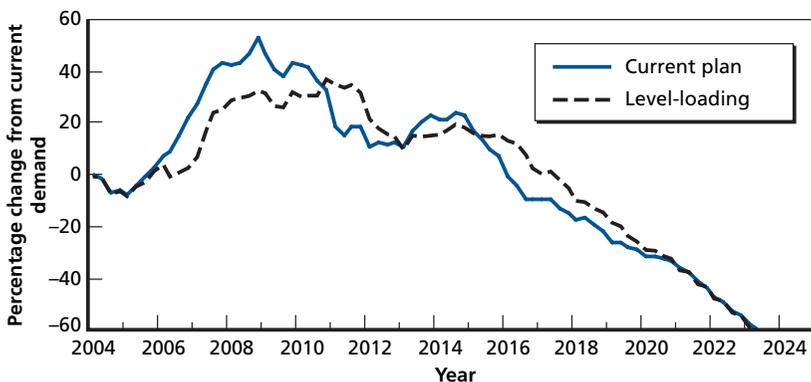
notable exception was the scenario that involved a Future Submarine, which could make substantial demands for technical workers past 2010.

One way that the MOD could reduce these peak demands would be to level-load the ship production plan, which would involve starting programmes earlier or later, extending their build schedules, and increasing their build intervals. However, the MOD will need to consider operational needs in determining whether such an approach is feasible. Figure S.3 shows the change in total, direct employment for the current plan and a level-loaded example relative to the demand in 2004.

Labour Supply

The naval shipbuilding and repair industry will be challenged to meet the peak workforce demands as outlined above. To determine the nature and extent of that challenge, the RAND team built a spreadsheet model to forecast the labour supply for naval shipbuilders and repairers. The team then compared the potential supply picture with the projected total demand under the current MOD plan and the

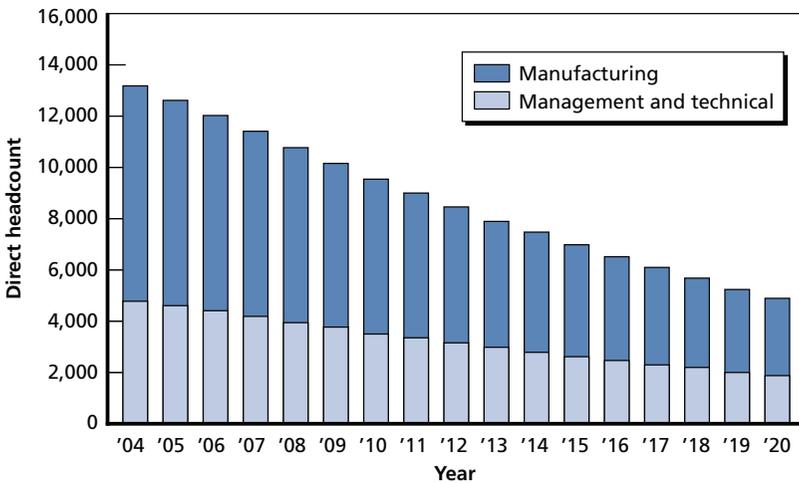
Figure S.3
Direct Labour Demands for the Current Plan and a Level-Loaded Example



level-loaded scenario described above. For the purposes of this analysis, the team combined the five skill subcategories into two: management/technical and manufacturing (structure, outfitting, and direct support). This simplification was required because of the limitations with data available.

As Figure S.4 indicates, the number of workers would drop from more than 12,000 workers to around 4,600 in the next 17 years if no steps are taken to replenish the workforce through hiring apprentices or experienced workers from other industries or from the ranks of the unemployed. We in no way suggest that the shipyards will not replace workers. In fact, several have active apprentice and recruiting programmes. Figure S.4 also shows how rapidly the current employment ranks decline because of the ageing of the workforce.

Figure S.4
Projected Shipyard Labour Supply Without Additional Recruitment,
2004–2020



Although there is no current shortage of workers, the shipyards expressed concern about their future ability to recruit particular skills (e.g., design, electrical, test and commissioning, and steel work). Many of the shipyards have begun apprentice programmes in recognition of the ageing problem that are aimed at maintaining current or core workforce levels and not necessarily to meet future peak workload.

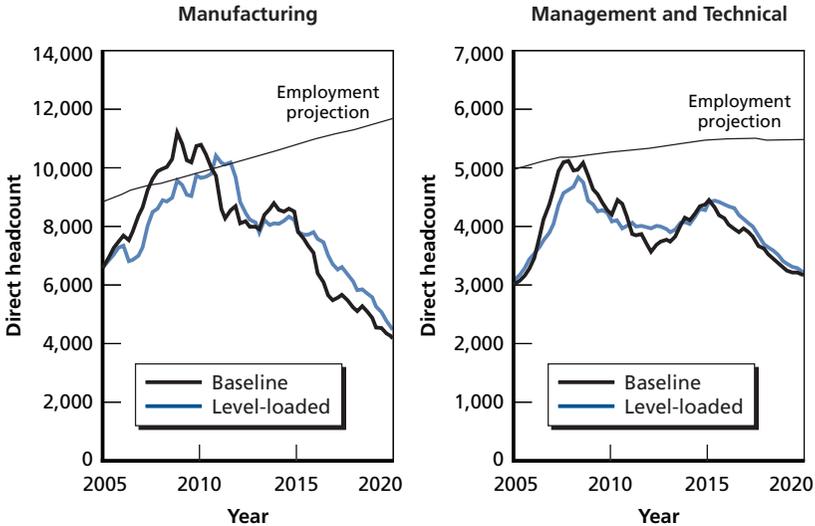
There are, of course, other labour sources from which the shipyards can draw workers. For example, some of the shipyards have recently made workers redundant and may be able to rehire these former workers. There is also the opportunity to draw workers from related industries and from among the general unemployed. Another alternative for the shipyards is to rely more heavily on outsourced activities, a trend that has been increasing as of late.⁷

Despite these additional sources of labour, the RAND team concluded that it will be difficult for the shipyards to grow to meet peak labour demands. Figure S.5 shows workload demand for the baseline and level-loading scenarios along with employment projections. Assuming a modest growth rate, the shipyards as a whole may not be able to meet peak labour demand for production workers. Even under the level-loaded scenario, shipyards will approximately meet the peak production demands. For the technical workforce, there are currently enough workers at the firms to grow to the needed peak levels, but only if these workers are retained through the near-term downturn. In all, meeting the peaks in workload demand will require that shipyards share work to a greater extent than they do now.

These supply and demand results present labour issues at an aggregate (macro) level to simplify the presentation and to protect business-sensitive information. The macro results are useful in that they portray the magnitude and the timing of the labour issues the

⁷ Of course, there is a limit to the extent that these activities can be outsourced. See Schank et al. (forthcoming) for more detail.

Figure S.5
Shipyards Employment Projections Versus Demand
(baseline and level-loaded)



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industry faces. However, the macro view masks the effect at an individual shipyard or firm level. In a sense, the macro view could be interpreted as a case in which there is an unlimited ability to share work between firms. Thus, where the macro-level demand might appear reasonable or achievable, there may be problems of either irregular or high demand for labour at an individual firm making such a plan difficult to implement.

How Will the MOD Programme Affect Shipyard Facilities?

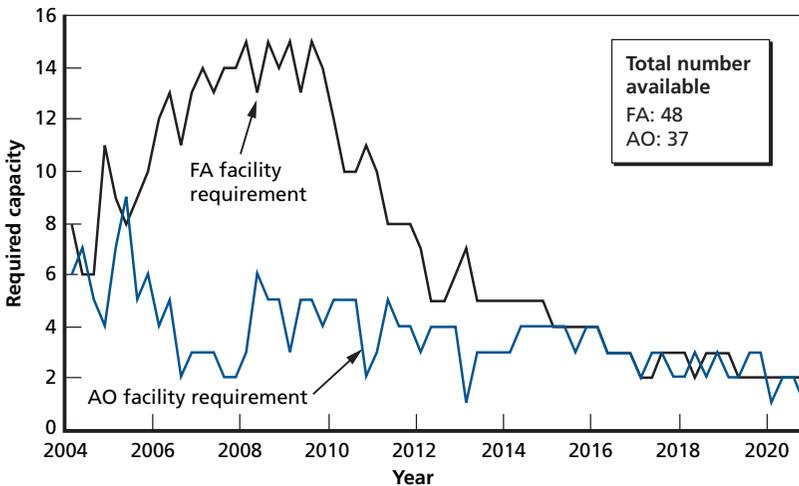
In this part of the analysis, the RAND study team focused on the facility implications of the current MOD plan. In particular, the team concentrated on final assembly facilities (docks, slipways, land-level areas, etc.) and afloat outfitting locations (mainly piers and quays).

The facilities considered included those at the naval shipyards and some commercial yards.

Not surprisingly, the RAND team found that different programmes likely will stress different facilities. In general, as Figure S.6 indicates, the demand for final assembly facilities will be particularly high between 2006 and 2010.⁸

The Type 45 programme will create a substantial demand for final assembly and outfitting locations because of the build interval between ships (assumed to be six months). Although the facilities on the Clyde might be able to handle this schedule (with facilities upgrades and some careful scheduling), extending the build interval of the Type 45 to nine months might help to alleviate any potential problems and make the build schedule more robust.

Figure S.6
Total UK Final Assembly and Afloat Outfitting Facility Requirements, 2004–2020



RAND MG294-S.6

⁸ Because of the sensitivity of the data, this demand does not include all refit and repair work.

The sheer size of the ships in the CVF and MARS programmes poses challenges. CVF assembly will require some facilities upgrades and investments because no assembly location today could handle the CVF ships without modification or upgrade. Further complicating the picture is whether the final CVF assembly location will also be used to build large block portions of the ship. There is a potential overlap between the assembly of the first hull and the production of blocks for the second hull. This overlap implies that the second hull's blocks will either need to start construction outside the final assembly dock or be delayed until the first hull leaves the dock.

Similarly, large MARS ships will be equally challenged for a final assembly location. Although there are facilities in the United Kingdom that could construct these ships, it is likely that at least two facilities (or a facility that can construct two ships at once) would be needed based on the notional delivery schedule of one ship per year. In most cases, any of these candidate facilities would need to be upgraded or reopened—thus requiring investment.

How Will the MOD Programme Affect Shipbuilding Suppliers?

More than half the unit cost value of a naval vessel is provided by firms other than the shipbuilder.⁹ So the ability of suppliers to meet the demand based on the MOD's plans is an important consideration in addressing the UK industry's capacity. The study's surveys of both the shipyards and the suppliers indicate that there will be generally few issues surrounding the increased workload for the suppliers. For the most part, the suppliers do not rely on MOD business, so they are less subject to the variations in demand (in contrast with the shipyards). Further, most of the suppliers are based in the United Kingdom. However, these suppliers have indicated that the uncertainty in

⁹ *The Clyde Shipyards Task Force Report* (2002, p. 41).

the MOD's programme hinders their ability to plan and invest in a timely way.

The Role of Nontraditional Sources for Naval Shipbuilding

The UK commercial shipbuilding and offshore industry have resources that may help to produce ships for the MOD. These resources are currently underemployed because of downturns in both sectors; therefore, these resources could be available to the MOD for its shipbuilding programme. Medium-sized shipbuilders¹⁰ have had a role in the past and could play a role in the production of future ship classes—from a builder of blocks and modules to a producer of smaller vessels. The offshore industry also has the potential to contribute to the programme. These firms have facilities and labour resources that could be employed—most notably in management and technical skills. However, its role, if any, will need to be carefully matched to its capabilities and skills. For programmes that are similar to commercial products, the commercial/offshore industry could play a broader role in management, design, and production. However, for combatant ships, their role will be more limited.

Issues for the MOD to Consider

The RAND team made short- and long-term observations for the MOD.

In the short term, the MOD could:

- *Consider ways to level-load the labour demand.* In essence, the MOD will need to carefully consider the timings of various programmes. Some programmes will need to be shifted later, while others may need to have increased build intervals. It may also be

¹⁰ Appledore (owned by DML), Ferguson Shipbuilders, and Harland and Wolff.

necessary to shift design work earlier to mitigate the near-term lack of demand (the near-term dip in technical labour demand). The DPA will need to consider the labour effects at the individual firm or shipyard level to achieve the benefits of level-loading. Thus, any level-loading plan will need to be developed in consultation with industry.

- *Work with the Department of Trade and Industry to encourage training in skills that are in demand outside the shipbuilding and repair industry.* The UK government and shipbuilding industry should focus on training skills that are readily employable outside shipbuilding. In this way, any resulting unemployment can be minimised.
- *Consider relaxing the shipbuilding industrial policy to mitigate problems resulting from peak demand.* The MOD should re-examine industrial policy with respect to obtaining work content overseas. For example, the policy might allow UK shipyards to obtain major units or subassemblies from abroad in cases in which there is peak demand and it is not possible to easily obtain that content domestically.
- *Encourage the use of more outsourcing.* One way that commercial shipbuilders manage variable workloads is to employ outsourcing vendors that provide services and goods.
- *Evaluate the future of shipbuilding at Barrow.* With the current realignment within BAE Systems, the Barrow-in-Furness facility is exclusively dedicated to submarine production. The end of surface ship building in Barrow resulted in significant redundancies and the closure of some facilities. Barrow remains an untapped source of production capability and could likely play a significant role in the coming shipbuilding programme.¹¹
- *Consider the use of medium-sized shipyards to meet some of this demand peak.* Shipyards such as Ferguson, Appledore, and Harland and Wolff could play a role in meeting the peak demands by constructing blocks or structural units. Ferguson and Apple-

¹¹ Since the original writing of the report, BAE Systems Naval Ships has stated that it is now possible to use Barrow surface ship capability.

dore could produce smaller naval vessels, like the survey vessels both have produced in the last few years. Harland and Wolff was, at one time, capable of producing large auxiliary vessels. Whether that capability could be cost-effectively reestablished remains to be seen.

- *Explore the utilisation of facilities for Type 45, CVF, and MARS.* There may be facility challenges for these programmes, and the MOD needs to understand where there are potential conflicts and the actions that can be taken to mitigate them.
- *Have the Supplier Relations Group (SRG) investigate suppliers that are thought to be at risk.* In our surveys, the shipyards identified certain suppliers they felt were at risk. It might be worthwhile for the SRG to interact with the shipyards and suppliers to better understand the ones at risk and any corrective actions required.

In the long term, the MOD should, among other things:

- *Make long-term industrial planning part of the acquisition process.* This type of planning must become part of the process that the MOD uses to define the timing for the various naval requirements. The potential benefits of long-term planning include the ability to understand financial implications, reduce cost and schedule risks, and anticipate future problems. A strategic examination of the overall build programme with respect to the industrial impact should be done at least annually with an outlook of 10 to 15 years.
- *Define an appropriate role for the offshore industry.*¹² Better work-sharing between the shipyards will be necessary to meet the peak labour demand. The offshore industry may help the naval shipbuilding industry bring this collaboration about. Although the offshore industry might not feature strongly in direct fabrica-

¹² That is, those firms involved in the design, manufacture, and support of capital facilities for oil and gas in the sea (mainly the North Sea for the United Kingdom).

tion, it might feature more prominently in assembly and integration.

- *Carefully consider the implications of foreign procurement of complete ships.* Because foreign procurement carries risks, we recommend that the MOD thoroughly take into account issues such as access to technology and political disruptions before procuring entire vessels from abroad. The UK government could allow shipyards to consider outsourcing work to foreign sources when there is a need to reduce a labour peak, workers are not available elsewhere in the United Kingdom, and workers would only be needed for a short period.
- *Encourage long-term investment through multi-ship contracts.* Most naval shipyards have not modernised facilities during the past several years. Longer-term contracts will allow the shipyards to justify this type of major investment. However, the experience of US programmes has shown that multi-ship contracts work best for mature designs. So, such an approach may not include the first-of-class ship.
- *Consider the feasibility of competition in light of industrial base constraints.* Competition may not always yield better prices or result in a balanced allocation of work under conditions in which there are high resource demands. In such an environment, it is possible that there will be fewer potential bidders on subsequent programmes, that bidders will take on more work than is optimal, or that shipyards will be less inclined to cooperate for fear of losing a competitive advantage.
- *Explore the advantages of common and/or compatible three-dimensional computer-assisted design/computer-aided manufacturing (CAD/CAM) design tools.* The MOD might want to facilitate a discussion among shipbuilding firms (and potentially include the CAD/CAM vendors) to explore whether they should adopt a common or interoperable design tool or establish standards so that design work can be easily interchanged.